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226 channels (*ava*) leading to the open sea. Suitable channels on the reef shelf through which the water from the lagoon flows back to the ocean with the ebbing tide are blocked (*yaaka*) and the fish caught. Fish caught by this method are the common reef and beach fish mentioned for weir trapping.

[133] 2. The seine net (*kupenga*) is used for beach and reef fish. Because the irregular coral bottom of the lagoon would soon rip the meshes of the net if dragged over the bottom, it is set, not hauled, for reef fish. Nets used for the small beach fish (*kalowa*) are dragged over the sandy bottoms close to the beach. Nets for reef fish are set on the seaward side of the reef shelf. Some men walk inward with the wings of the net while others on the lagoon side of the reef shelf walk seaward, beating the water with coconut-leaf butts to drive the fish toward the net. The wings are closed around the fish, which are clubbed to death in water about 4 feet deep. To use the seine net, whether by setting or hauling, is *yali kupenga*. The one net on the island at present is owned by the men of Ngake who sometimes use it on the reef off Ngake, at other times on the reef off Yato. When it is set off Yato, Yato men are always present; and the fish caught are fairly divided among the men of the two villages. Fish caught by this method include all the reef fish caught by spearing and by fish weirs.

227 3. The arched net with line (*tata tiaitini*) is used for reef fish. It is constructed on the principle of the Samoan arched net with line (*27*, pp. 477-478), but with different materials. As I did not see one in use, the description is based on informant's account. A special net is not made; the net from the *tao maiolo* is unlashed and used. It is laid flat on the ground. A small cord passes from each of the four corners of the net to make a sort of bridle which takes the place of the thin rods used in the Samoan net. To the apex of this bridle is fastened a hand line of sennit. The surface of the net is baited with *Tridacna* meat, and *Tridacna* shells are placed on the net mesh to act as sinkers. The net is let down from a canoe and laid on the bottom (*uolowaio*) in about 2 or 3 fathoms of water. The fisherman then dives to the bottom to spread out the net. When coral or reef fish swarm into the net to get the bait, it is quickly pulled up. The natural sag in the *tao maiolo* net is increased as it is drawn rapidly to the surface, making it a fairly deep bag net.

226 4. The scoop net (*tao maiolo*) is used from a canoe on the outside of the reef to catch all kinds of fish. The classic example of this type of fishing is flying-fish netting. The best time to catch flying fish is after a big squall (*tiwa onga*) which has the effect of bringing together the fish. Flying fish are sometimes caught by individual fishermen in single canoes, more often by a fleet of canoes (*uwa vaka*) which goes out by arrangement to fish competitively. For the purposes of this fishing, members of the crew are named according to the functions they perform. In a six-seater canoe (*yaka ono*) the crew members, starting from the steersman and moving toward the bow are: the captain, who is steersman and principal netter (*tao mauli*); the *uwiauli* ("mate"), who has charge of the canoe when the *tao mauli* is netting but paddles at other times and is also referred to as *te ola no te tao ngai*, because he gathers together the fish as the netter throws them into the canoe; the *tao nuri*, who paddles and also nets when the canoe is on a big shoal of fish; the *o lamia* or *te tata pua*, who paddles, bails, and gathers in the fish thrown by the second netter and is also responsible for the torches (in a six-seater canoe there is one torcher; in an eight-seater, two torchers); the *ola no te ulu* or *te tatuai*, who paddles and gathers the fish together and who with the second man (*tuwiauli*) is responsible for keeping the canoe straight to the reef and moving it as required when the other members of the canoe are netting or bailing; the *tao uwa* or *tao ulu*, who paddles, acts as a netter, and is responsible for warping the canoe (*lolo te vaka*) as it is swung head-on to the reef, so that the canoe is kept dead head-on to the reef and swings neither right nor left from this position. In smaller canoes with a crew of only three men, the netter is in the bow, the torcher in the center, and the steersman in the stern. Previously only men fished flying fish, but today women and girls occasionally go out with the fleet to act as paddlers and torchers.

226 227 A float (*makai*) used for catching flying fish from a stationary canoe was described by informants:

The float consists of a section of *makaseva* wood about 9 inches long and 3 inches in cross section. To each end of the float is fastened a line ranging in length from 18 inches to 6 feet. The two lines on the same float are of unequal lengths to avoid tangling when fish are hooked. Each line has a *yeki* hook which is baited with *unga* crab, *halewa*, or flying-fish meat. Several floats (*makai*) are allowed to float unattached around the canoe. When a float begins to bob, the fisherman paddles to it, disengages his fish and resets the float. Chum of *unga* crab meat is used to attract the fish to the float. The only fish caught by this method are members of the flying-fish family: *pipi*, *mahalo*, *malolo puna ahua*, and *malolo-ua* (large-bellied balloon *malolo* fish which is not eaten and only caught incidentally).

STILL-CANOE FISHING

226 Still-canoe fishing with a vertically descending line and dead bait is termed *taualo*; similar fishing with live bait is called *lulu*. When the *taualo* system is used with a *yeki* hook for small fish, the method is called *yekiyeki*. In both types of fishing not more than 50 fathoms of line are paid out and the canoe is anchored inside or outside the lagoon.

[502] Outside the reef the canoe is lodged onto the reef. The anchor line (*kauaua*) is hauled up from reef to canoe with dry coconut husks. A quarter husk is split longitudinally for about 6 inches and the line wedged into this split. The natural spring of the husk serves to keep the line fast. About 12 husk buoys (*pulu kaugalaugai*) are used for each 100 yards of anchor line. Several canoes fishing together are lined up in single file. The first canoe is lodged to the reef, and each of the other canoes is attached by about 10 yards of anchor line to the one in front. Canoes are lodged to the reef only in an offshore wind. Canoes anchored inside the lagoon are usually lodged with two anchors (any large stone serves as anchor), one at the bow, the other at the stern. In both *taualo* and *lulu* fishing the canoe is faced to windward, and the line is dropped in the lee of the canoe. Both types of fishing depend for success on an ability to see the fish biting the hook. To make the leeward surface of the water calm and devoid of surface rippling, the fisherman chews coconut flesh, which he spits on the sea. The oil in the flesh spreads over the water and effectively calms it. Today a wastegrass is often used instead of chewed flesh. Some fishermen prefer to fish the smaller lagoon fish when the sky is overcast and likely to rain, using composite shell hooks. Where *Tridacna* is used as chum, the backs of the opened shell are rubbed together, making a grating noise (*kukukuku*) to attract fish; the two half-shells with meat attached are thrown into the water near the canoe. Fish caught by the *taualo* method are:

1:Beaglehole and Beaglehole E-5 (1934-5)1938 Pukapukans

A man catches his *kaioma* bait in the morning. Besides his fishing gear and two or three coconuts for his day's lunch, he takes with him coconut-leaf mats (*pola kaioma*) which provide protection from sun and rain and serve as sails. A mat leaning against the fisherman's back while he waits for a bite is easily thrown aside when strenuous activity is required to haul up the fish on the line before the sharks can take the fish from the hook. When the canoe is lodged to the reef and there is only a gentle breeze blowing offshore, a mat sail is used to prevent drifting onto the reef, thus obviating the necessity of paddling out from the reef again and again. A big sail in a fishing canoe would be cumbersome and would catch too much wind. A mat standing up in the canoe, with vertical midrib base and light guys running to outrigger booms providing support, gives sufficient belly to catch the wind and keep the canoe off the reef without dragging anchor.

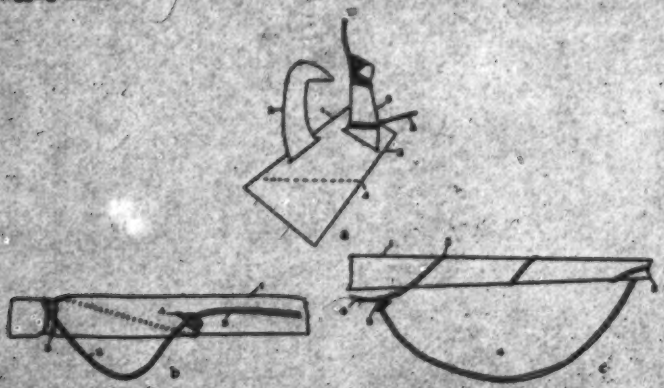


FIGURE 4.—Implements for fishing and bird snaring. *a*, fishhook with bait attached: any dead fish bait (*moana mate*) is attached to old-style hook by removing head from bait fish and stripping off fillet (1), excluding backbone from belly backward so that flesh remains whole; hook (2) thrust through tail end (3) of fillet from flesh side, back through head end of fillet from skin side; fillet folded (4) along hook (dotted line), flesh side outward, skin side inward, and tail end of fillet lashed to shank (5) of hook, near shank knob, by transverse turns of bait string (6), fastened with half hitches. *b*, bird noose (*pola moana*): pole (1) about 12 feet long, 2 inches in diameter; noose (2) two-ply twisted sennit; one end of sennit passed transversely around notch end of pole (3), then down underneath two transverse turns; short free end (4) tied in square knot on bight; running end (5) passes down pole to bird catcher's hands at proximal end. *c*, fish noose (*kaupola*) (C8152): wooden support (1) of *puapua* wood about 6 feet long, ½ inch in diameter at proximal end, ⅛ inch in diameter at distal end which is notched (2); noose cord (3) of strong, three-ply twisted sinnet, wound around support, passed over notch (2) to form noose (4); free end knotted on bight (5) and cord (6) passes to proximal end of support.

Tuku moana fishing from a stationary canoe outside the reef with dead bait differs in two respects from both *kalu* and *tauala* fishing: *tuku moana* fishing is deep-sea hand-line fishing up to about 300 fathoms and involves

1:Beaglehole and Beaglehole E-5 (1934-5)1938 Pukapukans

322 285 labors. If this place is not shady, the owner erects a shade of coconut mats (*tukapau*) on poles to protect workers and canoe timbers. Caulking material, lashing sennit, and canoe timbers are provided by the owner. The expert provides his own implements. (For the food financing and payment for the completed canoe, see p. 92).

322 354 461 Expert carpenters value their good name as quick workers and rarely dawdle over a job, because this would lay them open to criticism and would militate against further building contracts. As long as the expert and his assistants work conscientiously they are well fed. There are no songs or sayings about lazy carpenters, but a quick and skillful expert will be sure to have his name praised in a chant. Informants suggested that about one moon of continuous work with shell adzes was formerly required to finish an average-sized canoe.

322 531 Some experts possess a trade mark (*waka mailonga*) which they carve roughly on the front of the bow piece of canoes they build. Such a mark is the head of a fish, the beak of a bird, or some other part of an animal. Tualai puts a sign of two crossed hands on the wave guard (*malae puka*) of each canoe he builds.

552 Canoes may be named by their owners. An appropriate canoe name is *Te Mango* (Shark) or *Te Punga-o-Witi* (Coral-rock-of-Fiji). This name is mentioned to the people who attend the canoe-finishing feast (*inu kai waka maliunga*) and the canoe is henceforth known and referred to by this name. Today some men roughly carve or paint the name on the bow of the canoe.

Canoe Crew

502 793 The canoe crew is known collectively as *unoa vaka*. Specialized names for crew members of the flying-fish canoes have already been mentioned (p. 58). In general, the captain of the canoe crew is termed *tau muli vaka*. He is the steersman and leader of the crew. Formerly, especially for long distance voyages, he was usually a priest (*wata*). If he did not have priestly powers, one of his crew, who was a priest, consulted the gods in times of need.

502 The second member (*wuliwuli*) of the crew (moving from stern to bow) who sits on the aft cross boom (*kaukau ki muli*) is second in command and corresponds to mate. Should the captain die on a long voyage, he automatically takes command of the canoe. If the captain lays down his steering paddle to fish or rest, the *wuliwuli* takes up the steering. He helps to steer in strong seas or a high wind, and uses his paddle as a make-shift leeboard when the canoe is sailing by the wind. He further tends the main sheet (*uuua*) when the sail is up, watching wind pressure and direction.

The group of paddlers amidships are termed collectively *tataui*. They are

1:Beaglehole and Beaglehole E-5 (1934-5)1938 Pukapukans

502 charged with paddling the canoe and keeping it clear of water. In small canoes the man directly amidships is the bailer and is termed *tata yua*. The bowman is known as *hawya*. He is responsible for keeping a good lookout ahead, an especially important duty in shoal waters when he cons the canoe through the lagoon channels by directing the steering of the captain. He sits on the forward outrigger boom (*kaukau ki mua*) to keep the float down when the canoe is heeling over to a fresh wind. He alters the angle of the mast as required by the strength of the wind and uses his paddle as a leeboard if necessary. When it is necessary to turn the canoe quickly, he paddles at right angles to the canoe and thus helps the steersman. He is usually a strong, lively man as is demanded by his position.

322 Formerly tapus existed against the presence of women in canoes (p. 309)
782 and against desecrating a canoe by capsizing it. When work began on a
new voyaging canoe and again when the work was completed, a priest
562 commended the canoe to the protection of the gods of the owner's paternal
descent group. No details are remembered of these ceremonies, but they
778 appear to have rendered the canoe in some measure tapu. Before starting
793 a canoe voyage, the priest went to the worshiping place again to recommend the canoe to the protection of the god. No record is preserved of the type of god consultation carried out at sea, but informants suggested it was similar to consultations in the god house of the religious structure. The canoe priest probably took with him on the journey a stick or stone representative of his god to which a malo or coconut leaf could be tied when the priest communicated with the god. This would render the canoe still more sacred because in a sense the spirit of the god was considered as traveling with the priest on the canoe. To capsize a canoe by carelessness, lack of skill, or general bad temper was to treat the sacred canoe with less than proper consideration; it made the canoe *lepa* (violated the sanctity of a god), and the god was quick to punish this slight.

Care of Canoe

504 When canoes return from a fishing trip or other expedition, they are carried up the beach well above high-water mark and the hull, bow to the sea, is rested on chocks (*longo*). Sections of pandanus logs are split into halves longitudinally. The flat side rests on the ground. A notch is cut in the rounded upper surface of the chock and the hull of the canoe rested in this notch. Dry butt ends of coconut midribs and dry half coconut husks are also used as canoe chocks. Stern and bow pieces may be further supported by dry coconut midribs, the broad end of the butt with its natural notch serving to support the canoe piece. Small canoes and dugouts are sometimes turned bell up before resting outrigger booms on chocks.

1:Beaglehole and Beaglehole E-5 (1934-5)1938 Pukapukans

501 about the hull joins is seldom dry, and after about 10 years the wood be-
322 comes so rotten that the flanges break apart. The only remedy is to take
the canoe apart, adz off the rotten sections of wood, and rejoin the canoe
as a *vaka tui tuta*. The sennit lashing of the *vaka tui tuta* lasts about seven
[283] years before it rots. It is easily replaced if care has been taken of the
canoe and the wood round the joins has not become rotten through un-
suspected water seepage.

501 The customary Pukapukan canoe for deep-sea fishing or voyaging was
[226] the single outrigger canoe. At various times, however, the double canoe
(*taulua*) was made and used, particularly for regular fishing trips to Tima
177 Reef. A time is remembered when three double canoes were in commission
on the atoll. Tradition seems to indicate that the art of making double
canoes was introduced by returning Pukapukan navigators. The chief Wue
(who lived about 14 generations ago) is reputed by some to have been the
first man to build a double canoe in Pukapuka; he modeled it after one he
had seen in his travels abroad. Lack of sufficiently large timber is given as
the reason why few double canoes were built. No informant had seen a
Pukapukan double canoe. The following brief description is based on tra-
ditional information only:

The larger of the two canoes was to leeward and carried the two masts. The smaller canoe acted as an outrigger and was to windward. Cross booms (*kaukau*) joining the two canoes were probably legs of pandanus, three booms being necessary to provide a stable support. Both canoes were completely decked with logs of *poupou* wood, save for holes or hatchways that served as bailing cockpits and gave entrance to stores and fishing gear loaded inside the hull of the windward canoe. Diagonal cross braces from the stern and bow of each canoe to the fore and aft cross booms were termed *tokai*. A platform (*papanga taulua*) laid across the booms was occupied by the crew and passengers who also used the leeward canoe for shelter. On one part of the platform was placed a small house which functioned as a god house (*uale atua*). No details are preserved of lashings or sizes of these double canoes. But it is likely that the reason the single outrigger was the preferred canoe is that it could be made
502 more seaworthy because the outrigger could be more strongly lashed to the hull than
as the big and unwieldy double canoe. The double canoe was steered by two or three steering paddles, one man steering from one canoe and the second man from the platform between the canoes. Should a sudden turn be desired, the two steersmen were reinforced by a third who assisted from the stern of the second canoe.

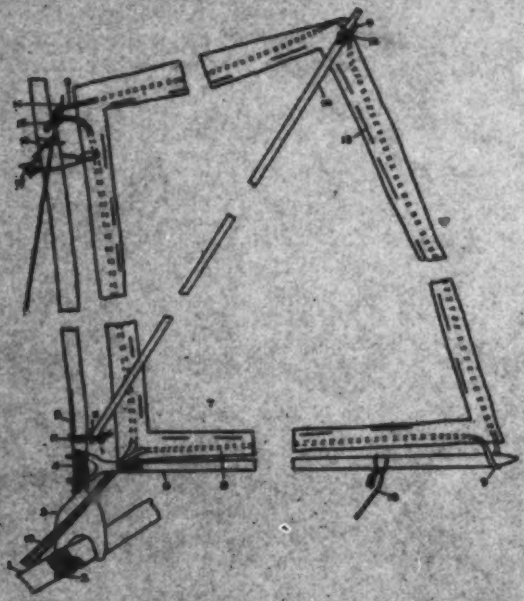
To change the direction of any canoe is *uuli* or *uuuuli*. The change of direction is to starboard (*ki hatea*) or to port (*ki ama*). The bowman calls out the direction of change thus: *La ama!* or *La hatea!* When the required direction is defined, he calls out: *Tousi a!!* (Hold it now!)

501 Variations on the fundamental construction pattern of the Pukapukan
322 canoe are few:

In one single-piece dugout canoe, rather large for its type, greater stability was given to the two outrigger cross booms by projecting the ends of these booms about 18 inches beyond the starboard side of the hull and lashing to these ends a longitudinal

1:Beaglehole and Beaglehole E-5 (1934-5)1938 Pukapukans

502 In a heavy wind, the mast of a triangular sail is kept vertical. To catch the greatest amount of moderate or light wind, it is hoisted over to an angle of about 30 degrees with the vertical. The boom runs from the mast at an angle of about 60 degrees, and the sail functions then with its base upward and the apex down. This is the usual way of mounting the triangular sail.



501 322 284 FIGURE 32.—Mast and gaff sail (*te hiki o Te Puke*): 1, cross boom to outrigger, on which crotch (*vae mangai*) (3) of mast (5) rests; 2, lashing on crossbar to prevent mast from slipping; 4, lashing binding crotch to mast spar (5); 6, boom with crotch resting against mast; 7, gaff sail; 8, becket sennit basted into overlap of sail; 9, beckets which pass over end of supporting spars and loop sail that; 10, sprit or gaff which extends outer peak of sail, resting at lower end in snotter (11) of sennit made by taking clove hitch around mast and tying free ends of sennit in overhand knot; at upper end of sprit, becket prevented from sliding down spar by lashing turns (12) taken around end of sprit; 13, heavy lines indicate sewing of overlap to hold becket sennit; 14, natural branch cleft (*vae mangai*), over which becket loops when sail is hauled up by means of guy (15) fastened to becket by clove hitch; 16, stays run to booms to support mast (see fig. 31, *c*); 17, sheet fastened to becket sennit with overhand knot and looped around mast with double overhand knot; only one sheet shown, but average sail has about six sheets for mast and for boom; 18, main sheet, fastened to boom by clove hitch, runs to miller seated aft in canoe; 19, two ends of becket sennit (*mauli ia*) pass to, and are fastened around, cross boom (1).

1:Beaglehole and Beaglehole E-5 (1934-5)1938 Pukapukans

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An extra sail support is needed with the gaff sail (fig. 32). This sprit is termed *toko*. At the lower end it rests in a snotter (*wahamanga no te toko*) fastened to the mast. In a strong wind blowing directly aft, the gaff sail is supported by a further stay that runs from the head of the sprit to the stern cross lifting bar, occasionally to the curve of the stern piece around which it is fastened.

For a one-man canoe for sailing to the islets, a rough-and-ready sail is made from a coconut-leaf mat (*tahapau*). A-pole is stepped in the canoe and lashed to the forward cross boom. The midrib side of the mat is fastened to the pole with sheets of coconut fiber (*kaiawa*) and the outer edges of the mat stayed by guys passing to the hand of the sailor who sits in the stern of the canoe and steers. A *tahapau* mat catches ample wind to speed along a small canoe.

The mast of any Pukapukan canoe is mounted at either end of the canoe, the outrigger being invariably kept to windward. The canoe can not tack without unshipping the mast and setting it up at the other end of the canoe. Sailing fast (*kaiaki* or *yolo*) in a heavy wind, some members of the crew rest their weight on the outrigger cross booms in order to counterbalance any tendency of the outrigger to lift out of the water. Under sail a Pukapukan canoe lies close to the wind, but tends to make rapid leeway for want of a keel.

Paddle and Bailer

The Pukapukan paddle (*wae*, fig. 26*d*) has a projecting knob (*wato*) at the distal end of the blade. This knob has a dual function. It protects the blade (*laulau wae*) when the canoe is being poled over lagoon shallows, and, when the paddle is brought from the water with a sharp wrench after a short jab stroke, the knob makes, in contact with the water, a short, sharp, ringing sound (*leo tangi te wae*), used to attract fish to the fishing canoes. It is a very characteristic sound in Pukapukan paddling, and wherever it is necessary to imitate a canoe in May Day play festivals, a file of men walk about making this sound with their lips, at the same time raising and lowering their arms.

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The paddle is used on both port and starboard sides of the canoe. The outrigger does not offer great impediment to the typical short, jabbing strokes of the Pukapukan paddler. Any paddle is used indifferently for steering and paddling. Formerly the paddle was always held with the back (*tua*) turned toward the rear of the canoe. This usage, (*ulo tua*) is reserved today for short sports and for making the paddle resound, the front (*alaalo* or *vaivaiuka*) of the paddle being now customarily directed toward the rear.

Each canoe has as part of its equipment a long pole (*tobe*) used for poling the canoe over reef shallows. Some canoes returning to Wale from Motu Ko ling the reef circuit and make good speed with two people poling, one in the bow and one in the stern.

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The bailer (*tata*, fig. 26*g*) is of common Polynesian type. It is not decorated with carving. In use, the bailer is not filled, lifted, and emptied over the side of the canoe, but water is gathered from the bottom of the hull and shot out with one vigorous and continuous scoop. In small canoes, an empty coconut shell serves as a bailer.

Measurements

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The principal measurements of seven Pukapukan canoes are given in Table 3. These measurements may be compared with those of the 13-seater canoe shown in figure 25.

The amount by which the forward end of the outrigger float is set to starboard to assist the steering qualities of the canoe ranges in the canoes measured from 2 to 6 inches, with an average of about 3½ inches. Pukapukan canoe builders gave no rule

821 Na Pongaponga-iyu-o-te-kiole, Nostrils-of-the-rat (visible binary, 4 ε Lyrae and 5 Lyrae). Some confusion over identification of the name. Likely that almost any visible binary may be correctly called by this name, in same way that Jupiter and Sirius may both be correctly called Tapao.

Te Tolunga-Mani, Three-Maui-Brothers (ζ, ε, and δ Orionis). Veti alone included Orion's sword as well as his belt in this constellation. Used as star course from Pukapuka to Oloseega and return.

Te Wao-a-Mani, Fishline-of-Maui (θ, η, ζ, ε, and δ Ophiuchi and α Serpentis). Most informants agreed on including these stars as the main ones in the Fishline, in reality a group of stars strung out north along the Milky Way from Scorpio. An unimportant constellation, figuring neither as star-course guide nor as fishing sign.

Taki-piki-tolu (group of stars in Piscis Australis). Veti and Pau maintain this identification, and refer Tolu alone to α, β, and γ Aquilae. Possibly this distinction is old.

Mataliki (Pleiades). Morning rising marks change of wind to southeast, heralds flying fish, reef fish, and bigger deep-sea fish (then full of roe) seasons. Hence the saying, "Tena te kau ika o Mataliki ka yau" (Here are all the fish of Mataliki coming). Formerly morning rising introduced the six-moon period of pleasuring. Mataliki directly overhead in the sky is a sign of turtles coming to lay eggs on the outer beaches.

Te Kau-o-Mani, Fishhook-of-Mani (cluster of 4th, 5th, and 6th magnitude stars in Sagittarius). Often confused with the tail of Scorpio, though it lies southeast from the southernmost stars in the tail.

Lua-tama-lelei, Two-beautiful-children or Lua-pulotu-koloi, Two-beauties-close-together (λ and υ Scorpionis). Their modern name, Pipili-ma, is said to be Tahitian.

Taumakomako (γ, α, and σ Scorpionis). Some informants do not recognize this constellation. Identification is doubtful, as it includes Antares, definitely named Melemele.

Te Ala-kaveinga-o-te-ika, Star-sign-of-fish (Ursa Major). Descriptive name only because this constellation is known by all as sign for reef fish. Pau's identification given above.

Te Mumu-o-ngana. Group of small stars known to some, could not be identified.

STAR COURSES

502 [487] The value of Pukapukan star courses from the viewpoint of modern navigation has been worked out by Robert Dean Frisbie, whose notes follow. The accuracy of the star courses to the west and from Samoa to Pukapuka is noteworthy. Informants knew of no star courses which would help a navigator sailing eastward from Pukapuka, an indication perhaps of the predominating contact of Pukapuka with western islands.

The course from Pukapuka to Niue was equal to the bearing of α and β Centauri (Na Mata-o-te-tokalua) when low in the sky to west of south. Informants emphasized that the stars must be low in the sky; evidently the old navigators were aware of the Centauri's rapid change of bearing when at a higher altitude (no such emphasis was laid on the Antares, or the ε Orionis, star course). Informants were not aware of the stars being in their lower transit when observed low in the sky; but a navigator sailing as far south as Niue, lat. 19° 10′ S., would undoubtedly observe this.

The true course from Pukapuka to Niue, calculated by Mercator sailing, is 204° 46′. The course that would be steered by a canoe headed toward α Centauri, at 5° altitude, would be equal to that star's bearing, which is, in the latitude of Pukapuka, 209° 10′. This is computed by the formula: $1/2\ Z = \sqrt{\cos.\ s,\ \cos.(s-p),\ \text{sec. L},\ \text{sec. h}}$. (In this $s = 1/2\ h+L+p$; Z is bearing; L, latitude; h, altitude; p, polar distances.)

1:Beaglehole and Beaglehole E-5 (1934-5) 1938 Pukapukans

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The course arrived at by the above altitude azimuth calculation is 4° 22′ to westward of the true course, and, if only one bearing was taken at the beginning of the course, it would take a canoe to a point approximately 39 miles to the westward of the south point on Niue. At this distance a native voyager would be aware of the proximity of land as well as its direction. He would, however, arrive at a point somewhat closer to the land, for as the canoe sailed south, α Centauri's bearing when low in the sky would shift to the south, due to the star's being in its lower transit. Thus the navigator, by degrees imperceptible to himself, would shift his course more and more to the south, as follows:

At Pukapuka the true course would be roughly 205° while the bearing of α Centauri is 209°.

After sailing 200 miles the true course would be 203.5° while the bearing of α Centauri would give a course of 208.5°.

After sailing another 200 miles the true course would be 197° while the bearing of α Centauri would give a course of 207.5°.

Another 100 miles and the true course would be 178° while by steering by α Centauri the navigator would be making a course 207°.

Finally, after following the last course for 65 miles, the navigator would fetch up at a point 31 miles to the west of Niue.

Steering by a course equal to α Centauri's bearing when lower in the sky would bring the navigator closer to Niue; while if the bearing of α Centauri was taken when it was high in the sky there would be little appreciable difference until the star was above 15°, when it would go into its upper transit. This rule, however, would not hold true when the canoe had made considerable southing, but the variation in the course made good would be slight.

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If, as some of the Pukapukans claim, Nassau was used by the old navigators as a point of departure, then a canoe headed for Niue would fetch up within 12 miles of the land. It is perhaps within reason that a navigator would stop at an uninhabited island, such as Nassau, where an abundance of food could be gathered for the voyage.

An interesting detail in relation to the α Centauri course lies in the fact that during July, August, and September, when the star sets during the early part of the night and thus is in a position to be used as a bearing, the normal winds in this part of the Pacific are favorable for the voyage to Niue, blowing steadily from the east to northeast.

Informants state that the old navigators steered a course to Upolu which was equal to the bearing of Antares (Melemele) when low in the sky to westward. As it is improbable that this star would be visible, over a period of nights, when below 15° altitude, that altitude has been used in calculating the true course that such a bearing would give. The results follow:

True course to Apia by Traverse Tables	243°
Course by Antares at 15° altitude	245°
Course by Antares (at setting. Amp. tab.)	243°

Antares is last seen to westward during the latter part of October, and thus it is in the western sky during the trade-wind months when the weather is favorable for the above voyage. Also, being a conspicuous red star, in a line with and between τ and σ Scorpionis, it is easy to pick out on a cloudy night.

Informants gave Orion's Belt (Te Tolunga-Maui) as the star course for the voyage from Pukapuka to Olosenga. Taking it at 15° altitude, the course equal to its bearing is 271.5°. As the true course is 264.5°, the star course is in error 7°, and this error would fetch the canoe to a point 31.5 miles to the north of Olosenga. Due to many kinds of sea birds nesting on Olosenga and flying far to sea to feed, the native voyager would be aware of the proximity of land as well as its direction well beyond a 31.5 mile radius. Also, it is probable that, after the first few voyages, navigators learned to sail a little to the left of Orion's Belt. Orion sets to westward during the early part of the trade-wind season, when the weather is favorable for the voyage. If, as one suggests,

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the voyagers made their departure from Nassau Island, they would fetch up within sight of Olosenga.

In sailing to the Gilbert-Ellice Islands, informants state that the navigators used Altair (Tolu). Sailing from Pukapuka, almost any course between 277° and 300° would take a canoe to a point close to one of the islands in the Ellice or the Gilbert groups. A course by Altair at setting is equal to 279°. As it rises higher in the sky its bearing swings to the north. It is visible at setting during the latter half of the trade-wind season when the weather is favorable for the voyage.

In voyaging from Samoa to Pukapuka, the Pukapukan navigators sailed from Upolu to Olosenga; then sailed on to Pukapuka using ζ, ϵ, and δ Orionis (Te Tolunga-Maui) as their star course. These stars would give a course of 88°, while the true course is 84°, and by taking from Traverse Tables under 4° (the difference between the true and the star course), and with the distance at 259 miles, one finds that the star course would put a canoe 18 miles to the south of Pukapuka. This is approximately at Tima Reef, which place would give a new point of departure for the canoe for the rest of the voyage. In case the canoe missed Tima Reef, due to bad steering or cloudy weather, it would still be likely to come within sight of Nassau or Pukapuka; and even if it missed all three landfalls, it could scarcely fail to come within a point 30 miles to the north or south of one of the islands, which point would be within sea-flight of the white terns—the sign of land. Hence, in sailing from Olosenga to Pukapuka, a distance of 259 miles, the navigator has a cross section of ocean, lying at 45° angle to his course, 110 miles long, in which to make his landfall.

Stress is laid on this point, for, to a casual observer, it seems little short of miraculous for a canoe to pick up a tiny atoll in mid-ocean. As a matter of fact, in the above case, it would be remarkable if the voyagers missed one of the two islands or Tima Reef.

Finally, the Orion's Belt course from Olosenga to Pukapuka is peculiarly advantageous as these stars are visible to eastward during the early part of the hurricane season when the winds are favorable for the return voyage. Later in the hurricane season—February and March—the winds are also westerly, but it is doubtful if a canoe would attempt the return voyage during these stormy months and, moreover, Orion's Belt would be too high in the sky to be used as a bearing. It is most likely that the return voyage would be made in December, when the winds are light from the west and Orion's Belt is low in the sky to eastward at sunset.

COUNTS AND MEASURES

The Pukapukan system of counting follows the general Polynesian system. It shows a high development of number prefixes used when counting different classes of objects. The list of numerals is:

1.	Tayi	20.	Lau lua
2.	Lua	30.	Lau tolu
3.	Tolu	100.	Lau
4.	Wa	101.	Lau ma tayi
5.	Lima	111.	Lau ma laungaulu ma tayi
6.	One	200.	Lau lau
7.	Witu	300.	Tolunga lau
8.	Valu	400.	Wanga lau
9.	Iva	1000.	Mano
10.	Katoa or laungaulu	2000.	Lua mano
11.	Laungaulu ma tayi	10,000(?).	Tini
12.	Laungaulu ma lua	100,000(?).	Ngaulu tini

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173 amoont of talo grown in the reserve of Uta, hence the saying that is remembered to this day: "Te konga nei, kua kaina te tuli ngauta i Yayake" (This place reminds me that the talo buds of Yayake are only big enough to be devoured by *tuli* birds). After a long visit in Pukapuka and several trips back and forth between Wale and Nassau, Te Palo sewed his sail for the return journey to Yayake with the arm bone of Malele, a demon that he had previously killed in Yayake. The goddess Tuna was so annoyed at this use of human bone which was tapu on Pukapuka that she infected Te Palo's armpit with a tumor to remind him of this fact on his way home. This visit of Te Palo is chiefly remembered for his adventures with Pukapukan women, the speed of his sailing canoe, and the tapu against the use of human bone.

173 [502] 484 As a general rule voyages made by members of Matanga lineage with their sacred maid in the canoe were safe. (See p. 239.) An exception to this rule is stated by informants to have taken place during the time of the chief Maina. But it must have been later, because it is further stated that about 7 to 10 canoes, containing in all about 100 persons from Matanga, composed the expedition, and there could not have been so many people in Matanga so soon after the devastating seismic wave. The captain of the expedition is not known, but it is remembered that the sacred maid of Matanga, Nokaulava, accompanied the fleet of canoes to give power (*uakamana*) to the sailing.

The fleet sailed from Pukapuka to the southwest and came up to a land called Tonga. Owing to the exhaustion of the crews it was necessary to land. The canoes were beached, but the people of Tonga rushed down upon the exhausted men and killed them all. Nokaulava had been hidden in the hole in the bow cover (*puoyo*) of the chief canoe when trouble threatened. She was found after the fight by the chief of Tonga, a man called Tautonga. He was struck by her beauty, and in order to save her life he hastily thrust her back into her hiding place and announced casually to the people that all the strangers had been well killed. He remained close to the canoe, guarding the girl until nightfall, when he secretly took her from her hiding place, and, carrying her over his shoulder, ran swiftly inland to the top of a mountain peak. Here he found a cave shelter for her and food in the near-by valley. He became enamoured with her beauty, and stayed with her for many moons, the people knowing nothing of her hiding place. The girl reciprocated his love, and soon was pregnant. Later she bore him a son named Moko, who rapidly grew up to be a sturdy lad.

She taught the boy the language and stories of Pukapuka, and all the wisdom of her atoll home that she could recall. Now and then she would ask the boy: "Taku tama e, ka ni o mo mea la langa ake te inu o to taua kainga?" (My child, have you yet the strength to prepare the oven—revenge—for our lineage?). The boy would not reply, but he kept the words close to his stomach. His mother saw this and was satisfied.

As the boy grew up, he trained himself in his solitariness with all kinds of trials of strength, lifting heavy rocks and tree trunks. His father saw this and was pleased. His mother was happy too, because she knew full well that his strength boded ill for her enemies. The boy climbed the highest mountain ridges and again his parents were surprised at the endurance and hardness of his body.

One day his mother took the boy aside, and told him the tragic fate of his people at the hands of the Tongans who lived by the shore. The boy wished to go to the coast to see these people. His mother allowed him to slip away from the mountain at night and he went to the shore, leaping from house ridge to house ridge, so that none would see him walking. Another time he went to the shore by daylight, stole a canoe and a pig, and paddled out onto the lagoon close to the villages. Then holding aloft the pig, he called out, "Look, you people of Tonga, can you do this?", and with his naked hands

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This disastrous voyage to Samoa is probably the last of the deep-sea voyages of the Pukapukans to foreign lands. Occasional fishing trips are still made to Tima reef, but there is no record in recent years of any deep-sea voyage with native canoes.

Summary

A survey of the voyages recorded in the previous pages indicates that the majority were made to lands to the west of Pukapuka. The Tokelau Islands, Tonga, Niue, and Samoa were frequently visited. It is perhaps reasonable to assume that some of the other names mentioned refer to islands to the north of Pukapuka, the Equatorial Islands. The land of Yayake still remains a puzzle, not rendered more easily solvable by the reference to Rarotonga. As this land is identified by some as Tahiti, it may be instructive to discuss the possibility of canoe voyages between Pukapuka and Tahiti. I am indebted to Robert Dean Frisbie for the material on navigation in the following paragraphs:

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The island of Raiatea may be used as a destination rather than Tahiti because it is closer to Pukapuka (940 miles) than is Tahiti (1080 miles), and it would be sighted by a canoe sailing direct from Pukapuka to Tahiti. The navigator's course to Raiatea from Pukapuka is 112° east southeast.

A canoe sailing from Pukapuka to Raiatea would require a light wind from northeast by north or farther north. No wind to the east of 32° would be serviceable because a native canoe at sea can not make good more than one point into the wind and if the wind blows at more than force 3 (Beaufort scale), the canoe can not make good a course closer than 90° to the wind. Winds from north of northeast blow in this part of the Pacific only during the hurricane season from November to March. At Pukapuka northerly winds are fairly steady and moderate, but to the eastward, these northerly winds give way to easterly winds. A wind shift to the north is generally followed by a gale from the northwest which a Polynesian canoe could not weather.

It would be practically impossible for a Pukapukan canoe to beat to Tahiti against a head wind. To do this, it could scarcely make more than 20 miles a day on a true course, and for this it would have to sail a little over 100 miles each day. A canoe beating towards Tahiti would be at sea for at least 47 days, changing the course continually as the wind shifted. If, at the end of this time, any island of the Society group was sighted, it would be due to singular luck and not design. No star course would be of value, for the canoe would be changing course continually. Even if a navigator knew by experience that a certain star at rising lies towards Tahiti, it would be impossible for him to shift his courses so that they would average one equal to the true star course.

All this does not discredit the fact that the early Pukapukan navigators could and did make long sea voyages with a fair or even a beam wind, short voyages also with a head wind if the wind was mild and the navigator was clever enough to keep track of his position. That the Pukapukans were well aware of the impossibility of long voyages against a head wind in the hurricane season is shown by the fact that when they sailed to Upolu from Pukapuka they had a fair wind; coming back to Pukapuka, they did not attempt to sail direct (against the wind), but sailed first to the Tokelau Islands,

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waited there for the hurricane season, and, as is demonstrated by their star course, then sailed back to Pukapuka with a beam wind.

The only possible way for a Pukapukan navigator to reach Tahiti from Pukapuka would be to make easting in short journeys from island to island, in high equatorial latitudes, during November or December, wait, say, at Tongareva, for a mild northerly wind, and then make more easting before the wind shifted back to west so that he was in a position to sail the rest of the way to Tahiti with a beam wind. Mr. Frisbie regards this as possible on paper but difficult in actual fact. A return voyage from Tahiti to Pukapuka would not be so difficult. It might take about 10 days or more under favorable conditions, though it might be relatively hard to make a landfall at Pukapuka.

Pukapukan traditions speak of several voyages to and from Yayake. In the light of the above-mentioned navigational difficulties and the fact that the Yayake people in their immigration to Pukapuka landed and settled on the southern side of Motu Ko, it is perhaps justifiable to assume that Yayake was not to the east of Pukapuka, but somewhere to the south or west. This would lead to the suggestion that Yayake lay in the direction of Tonga, and it is quite within the realm of possibility that this is the old Pukapukan name for an island there or for one of the Fijian islands.

MASTER IDEAS OF PUKAPUKAN CULTURE

The key to the patterns of social organization is to be found in a brief analysis of the master ideas or controlling motifs of Pukapukan culture. These are both extraverted and realistic. The realistic construct of the culture is evident in social patterns, in myth, story, chant, and in everyday life. Thus, when the Pukapukan has occasion to greet an old, sick woman, hobbling along the village road, he remarks: "Where are you going, lady, you with your sickly and crippled walk?" There is no felt need to gloss over the situation and insinuate, as with us, that all is for the best and that even a semi-invalid is walking better each day. Again, when one asks an old man, obviously soon about to die, to name his descent lineage, more often than not the question one puts is: "Where are they going to bury you, old man, when you die in a day or so?" No offence is ever taken at the apparent crudity of such questioning; the old man is fully cognizant of the fact of death and is able realistically to face it and joke about it. This is in line with the general Pukapukan attitude toward death; it is one of extreme realism, not at all one of fear, though fear may come later when it is suspected that spirits of the dead are malicious trouble makers. Again, Pukapukan humor concerns itself almost exclusively with either the functioning of physiological processes in other than the appropriate social situation,